DUDLEY KNOX LIBRARY
NAVAL POSTGRADUATE SCHOOL
MONTEREY, CALIFORNIA 93943

NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

AN UPDATE OF THE FUNCTIONAL REQUIREMENTS OF THE NAVAL AVIATION LOGISTICS COMMAND MANAGEMENT INFORMATION SYSTEM (NALCOMIS)

by

James W. Puffer

March 1984

Thesis Advisor: Daniel R. Dolk

Approved for public release; distribution unlimited.

DUDLEY KNOX LIBRARY

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle) An Update of the Functional Requirements of the Naval Aviation Logistics Command Management Information System (NALCOMIS)	5. TYPE OF REPORT & PERIOD COVERED Master's Thesis March 1984
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) James W. Puffer	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Postgraduate School Monterey, California 93943	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Postgraduate School Monterey, California 93943	12. REPORT DATE March 1984
	13. NUMBER OF PAGES 84
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)	15. SECURITY CLASS. (of this report) Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Naval Aviation Logistics Command Management Information System (NALCOMIS)

Status Inventory Data Management System (SIDMS)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Efforts to improve Naval Aviation readiness have taken the form of automated aviation maintenance management information systems. The Naval Aviation Logistics Command Management Information System (NALCOMIS) is a large complex system that has been in development since the mid 1970s. An interim system of a smaller scale, Status Inventory Data Management

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 55 IS OBSOLETE

S/N 0102-LF-014-6601

 SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

20. ABSTRACT (Continued)

System (SIDMS), has been operational on Atlantic Fleet aircraft carriers for over two years.

This thesis updates the functional requirements of NALCOMIS based on inputs from operational users of the interim system SIDMS. Data from questionnaires and structured personal interviews provide conclusions as to which functional requirements are most important/useful and which are least important/useful from a user point of view. The conclusions provide guidance for NALCOMIS implementation.

Approved for public release; distribution unlimited.

An Update of the Functional Requirements of the Naval Aviation Logistics Command Management Information System (NALCOMIS)

by

James W. Puffer
Commander, United States Navy
B.A., University of Colorado, 1966

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN INFORMATION SYSTEMS

from the

NAVAL POSTGRADUATE SCHOOL
March 1984

ABSTRACT

Efforts to improve Naval Aviation readiness have taken the form of automated aviation maintenance management information systems. The Naval Aviation Logistics Command Management Information System (NALCOMIS) is a large complex system that has been in development since the mid 1970s. An interim system of a smaller scale, Status Inventory Data Management System (SIDMS), has been operational on Atlantic Fleet aircraft carriers for over two years.

This thesis updates the functional requirements of NALCOMIS based on inputs from operational users of the interim system SIDMS. Data from questionnaires and structured personal interviews provide conclusions as to which functional requirements are most important/useful and which are least important/useful from a user point of view. The conclusions provide guidance for NALCOMIS implementation.

TABLE OF CONTENTS

I. INTRODUCTION 11

A. BACKGROUND 11

B. RESEARCH OBJECTIVES 13

C. SCOPE 14

D. METHODOLOGY 15

II. SIDMS OVERVIEW 17

A. BACKGROUND 17

B. OBJECTIVES 18

C. HISTORY 19

D. CURRENT CAPABILITIES 21

E. LESSONS LEARNED 26

F. OPERATIONAL EVALUATIONS 27

G. FUTURE DEVELOPMENTS 28

III. NALCOMIS OVERVIEW 30

A. BACKGROUND 30

B. OBJECTIVES 32

C. NALCOMIS DESCRIPTION 32

D. MINIMUM CAPABILITIES 34

E. ALTERNATIVE SELECTION 35

F. COSTS 36

G. BENEFITS 39

H. NALCOMIS DESIGN MODIFICATION 40

IV. USER/FUNCTIONAL REQUIREMENTS 43
A. RESEARCH QUESTIONS 43
B. DATA COLLECTION METHODOLOGY 45
C. SAMPLE SELECTION/QUALIFICATIONS 46
D. STATISTICAL ANALYSIS 47
E. DATA PRESENTATION--QUESTIONNAIRE 48
F. DATA INTERPRETATION--QUESTIONNAIRE 54
G. DATA PRESENTATION--INTERVIEW 58
H. DATA INTERPRETATION--INTERVIEW 64
V. CONCLUSIONS/RECOMMENDATIONS 67
A. CONCLUSIONS 67
B. RECOMMENDATIONS 70
LIST OF REFERENCES 72
APPENDIX A: QUESTIONNAIRE 74
APPENDIX B: INTERVIEW 77
INITIAL DISTRIBUTION LIST 83

ABBREVIATIONS AND ACRONYMS

ADP	Automated Data Processing
ADPE	Automated Data Processing Equipment
AIMD	Aircraft Intermediate Maintenance Department
AIRLANT	Air Forces, U.S. Atlantic Fleet
AIRPAC	Air Forces, U.S. Pacific Fleet
ANSI	American National Standards Institute
AN/UYK-5	Standard Navy Shipboard Computer
ASD	Aircraft Statistical Data
AVCAL	Aviation Consolidated Allowance List
AWM	Awaiting Maintenance
AWP	Awaiting Parts
BCM	Beyond Capability of Maintenance
BUNO	Bureau Number (Navy Aircraft Serial Number)
CAMSI	Carrier Aircraft Maintenance Support Improvement
CDA	Central Design Agency
CHNAVMAT	Chief of Naval Material
CNAL	Commander Naval Air Force, U.S. Atlantic Fleet
CNAP	Commander Naval Air Force, U.S. Pacific Fleet
CNO	Chief of Naval Operations
COBOL	Common Business Oriented Language
CODASYL	Conference on Data Systems Languages
COSAL	Coordinated Shipboard Allowance List
CRT	Cathode Ray Tube

CV	Aircraft Carrier
DBMS	Data Base Management System
DD-1348	DOD Single Line Item Requisition
DOD or DoD	Department of Defense
DON	Department of the Navy
ETR	Engine Transaction Report
FD	Functional Description
FMC	Full Missions Capable
FMSO	Fleet Material Support Office
ICRL	Individual Component Repair List
IFARS	Individual Flight Activity Reporting System
ILS	Integrated Logistics Support
IMA	Intermediate Maintenance Activity
IMRL	Individual Material Readiness List
I/O	Input/Output
JCN	Job Control Number
KVDT	Key Video Display Terminal
3-M	Maintenance Material Management System
MAG	Marine Corps Aircraft Group
MCAS	Marine Corps Air Station
MDS	Maintenance Data System
MDR	Maintenance Data Reporting
MHA	Manhour Accounting
MILSTRIP	Military Standard Requisitioning and Issue Procedure
MIS	Management Information System

NALCOMIS	Naval Aviation Logistics Command Management Information System
NAMP	Naval Aviation Maintenance Program
NAS	Naval Air Station
NAVAIR	Naval Air Systems Command
NAVMAT	Naval Material Command
NAVMASSO	Navy Management Systems Support Office
NAVSUP	Naval Supply Command
NMCM	Not Mission Capable, Maintenance
NMCS	Not Mission Capable, Supply
NSN	National Stock Number
OMA	Organizational Maintenance Activity
PMA	Project Manager Aviation
PMCS	Partial Mission Capable, Supply
PME	Precision Measuring Equipment
P/N	Part Number
RPS	Remote Peripheral Subsystem
SACOMIS	Shipboard Aviation Command Management Information System
SCIR	Subsystem Capability Impact Reporting
SIDMS	Status Inventory Data Management System
SNAP	Shipboard Non-Tactical ADP Program
SOCIDAB	Site Oriented Centralized and Integrated Data Base
SPCC	Ship's Parts Control Center
SRS	Supply Response Section

SUADPS	Shipboard Uniform Automated Data Processing System
TAT	Turn Around Time
TDC	Technical Directive Compliance
T/M/S	Type/Model/Series
VIDS/MAF	Visual Information Display System/Maintenance Action Form

I. INTRODUCTION

A. BACKGROUND

The cost of Navy aircraft and their associated weapon systems have increased from less than $1M each immediately following World War II to over $15M for some aircraft in the present [Ref. 1]. The number of aircraft in the Navy inventory has decreased to approximately one third that of thirty years ago. This still represents about 5000 aircraft valued at $23B, with a supply inventory of about $3.4B [Ref. 2]. Maintaining assets of this value in peak material condition and full mission capability is a primary concern of naval leaders from the Chief of Naval Operations (CNO) down to the squadron maintenance officer.

As the complexity of naval aircraft has increased, so have the associated maintenance requirements. The major problem facing the Naval Aviation Community is the decline of mission capability in spite of the efforts of maintenance managers to reverse the downward trend [Ref. 1]. This problem has been recognized for some time. In 1970 the CNO established a program to improve carrier aircraft readiness with the Carrier Aircraft Maintenance Support Improvement program (CAMSI). One of the major findings of the CAMSI program was that the improved use of ADPE was the most

practical, cost effective means of improving shipboard aircraft maintenance and support.

Several follow-on programs resulted and in 1976 the CNO approved an automated data system project, the Naval Aviation Logistics Command Management Information System (NALCOMIS). NALCOMIS was created to automate Naval Aviation Maintenance reporting, record keeping and data collection which would encompass not only aircraft carriers but also helicopter carriers, Naval Air Stations and Marine Corps Air Stations. The functional requirements for NALCOMIS were determined in 1976. The design, development and implementation have been underway from 1977 to the present.

During the lengthy development of NALCOMIS, fleet aircraft maintenance managers were experiencing production backlogs which continued to grow. After several attempts, an interim system named Status Inventory Data Management System (SIDMS) was developed on Atlantic Fleet aircraft carriers. Although smaller in scope than NALCOMIS, the interim system, SIDMS, was to provide a real-time monitoring of all aviation repairable actions taking place in the Aircraft Intermediate Maintenance Department (AIMD) and logistic support operations in the afloat Supply Support Center (SSC) of an aircraft carrier. SIDMS has been operational on Atlantic Fleet aircraft carriers for two years now, providing experienced fleet users with an interim management information system (MIS) in support of naval aviation maintenance.

Previous research on NALCOMIS includes two theses from the Naval Postgraduate School; by BOSTON [Ref. 3] and RODENBARGER [Ref. 4]. Both of these documents provided valuable background information on NALCOMIS.

B. RESEARCH OBJECTIVES

Determining user/functional requirements is one of the most difficult parts of systems design and analysis. As Bennett [Ref. 5] points out, "Users don't know what they want or need, but they do know what they like."

The objective of this thesis is to update the functional requirements of the Naval Aviation Logistics Command Management Information System (NALCOMIS) based on information from users having recent operational experience with the interim Status Inventory Data Management System (SIDMS).

In 1976 when the original functional requirements for NALCOMIS were determined, there wasn't even an interim naval aviation maintenance MIS for users to decide what they "liked." It makes good sense when trying to determine user/functional requirements to go directly to the users themselves. User involvement in systems analysis and design should take precedence over hardware or software orientations [Ref. 6].

There are several advantages to building information systems which are truly user-oriented.

1. The resulting system will be more likely to reflect the true information needs of the users.

2. The true capabilities of the people who will operate the system will be considered.

3. By involving the user in all stages, there may be higher user acceptance of the completed system since it involved a team effort rather than a product dictated by outside computer specialists.

It has been a number of years since the original functional requirements were determined for NALCOMIS and in that time user needs and priorities could have changed. Some of the concerns that this thesis will address are an investigation of the most important/useful functions of SIDMS, its advantages over manual systems, specific information needs, reporting requirements and any lessons learned through user experience. The relevance of SIDMS to NALCOMIS has become increasingly important since SIDMS has been converted to run on SNAP I hardware for AIRPAC carriers and SIDMS might be version #0 of NALCOMIS.

C. SCOPE

In any large MIS such as NALCOMIS the functional requirements range from providing information to the shipboard maintenance manager to reporting information upline to high level management. Since the shipboard users were the primary users and benefactors of SIDMS and NALCOMIS, only the functional requirements of the shipboard user were considered in this thesis.

1. Assumptions: the audience should have a basic working knowledge of naval aviation maintenance and the functions and capabilities of a management information system.

2. Limitations: because of the large number of Atlantic Fleet aircraft carriers deployed at the present time, it was only possible to interview personnel ashore who had operational experience with SIDMS.

D. METHODOLOGY

The instruments used to collect data were a questionnaire and an interview form. The questionnaire asks respondents to rate 39 items on a scale of importance/usefulness from A to E with A being most important/useful and E being least important/useful. The ranking scales were taken from the U.S. Army Questionnaire Construction Manual [Ref. 7]. The items themselves were taken from the functional requirements of SIDMS and NALCOMIS. They were field tested on Navy personnel familiar with both SIDMS and NALCOMIS and military and civilian faculty and staff at the Naval Postgraduate School. Samples of the actual questionnaire and interview form are found in Appendices A and B.

The data collection method included personal interviews and face-to-face questionnaire completion. This assured the return of completed data collection forms and certain knowledge of who provided the information. The alternative

of larger scale mailing of questionnaires was considered and rejected because of the uncertainties of who would actually fill out the form, whether it would be returned and the inability to clarify points or answer questions for the respondent. Although this approach limited the number of respondents, it was deemed better to have a smaller amount of valid information than a larger amount of questionably valid data.

As Kroenke [Ref. 8] points out, an easy and inexpensive method for gathering data about a data base system is to interview current users. This is why only experienced users of the interim system SIDMS were selected as respondents and personally interviewed. Kroenke also mentions that when a project runs into cost or scheduling difficulties, users are asked to prioritize their requirements. Part of the questionnaire asked respondents to rank the top five most important/useful functions. This could be valuable to the NALCOMIS program manager in the event reductions in scope become necessary.

II. SIDMS OVERVIEW

A. BACKGROUND

Status, Inventory, Data Management System (SIDMS) is a real-time aviation maintenance and logistics Management Information System (MIS) to monitor all repair actions taking place aboard an aircraft carrier (CV) in the Aircraft Intermediate Maintenance Department and logistics support in the Supply Support Center (SSC) [Ref. 9]. Data inputs come from AIMD, supply, and embarked squadron aviation maintenance personnel. They are combined in an interactive real-time data base from which "up-to-the-minute" CRT displays or hardcopy reports may be drawn. The primary reason for the development of SIDMS was the immediate need for an aviation maintenance MIS and the delayed implementation of NALCOMIS until 1985/86.

Some of SIDMS's advantages are: immediate help for aviation maintenance managers in the fleet, associated improvement in aircraft readiness, development of user experience, and displacement of nonstandard systems. The real key to SIDMS's effectiveness is the improved utilization of already existing resources. This is accomplished through reducing repairable component Turnaround Times (TAT) and supply response time, e.g. time to repair a broken part or time to order and receive a new replacement part.

B. OBJECTIVES

1. Improve EXREP (Expeditious Repair) Management/Turn-around Time. If an inoperative component can be repaired in less time, then the aircraft it was removed from will be out of service less time, thus improving readiness.

2. Improve Rotable Pool Management. Rotable pool items are spare aircraft systems or subsystems which are to be issued when an inoperative subsystem is removed from an aircraft and turned in for replacement. The turn-in is then repaired and put back in the rotable pool for future use. By keeping the rotable pool fully stocked, aircraft down time will be reduced.

3. Reduce Supply Response Time. Supply response times are the elapsed times from ordering a part from the ship's supply department to actually receiving the part. One way to reduce the supply response time is a fast and reliable means of converting a part number (P/N) to a National Stock Number (NSN).

4. Improve Aviation Demand Data. By knowing which parts are ordered and how frequently, the limited parts storage space aboard an aircraft carrier can be better utilized to stock the right parts in the right quantities.

5. Improve AIMD Personnel Utilization. A supervisor must have workload "visibility" of both current critical needs and overall workload mix to properly set work priorities.

6. Improve AIMD Material/Equipment Management. Knowing exactly what maintenance equipment, test benches and support equipment are operational, e.g. the current AIMD repair capability or Individual Component Repair Capability, (ICRL) would a tremendous management tool.

7. Integrated, Real-Time Data. By using a real-time data base management system, maintenance managers, supply managers and operational commanders are all dealing with the same up-to-the-minute information.

C. HISTORY

High production backlogs, innumerable supply support and work status details and inadequate management tools indicated the need for computerized help. This was not a new problem and had been recognized in 1970 by the Shipboard Maintenance and Supply Support Survey Team. Other studies of the same period cited lack of integration of AIMD and SSC, poor shipboard communications, unresponsiveness of AIMDs to airwing maintenance priorities and lack of status of current rotable pool assets as impediments to improved readiness [Ref. 9].

As a result of a Chief of Naval Operations (CNO) study in 1975, the Improved Aviation Repairables Afloat Program was formed. It later recommended prototyping a repairables management program aboard USS SARATOGA (CV-60) in 1975/76. Although the prototype program met with only limited success due to hardware difficulties, an automated material

requisitioning system using CRT's, teletype printers, and capturing demand data on magnetic tape became the leading edge of communications improvement.

In a separate development effort abord USS JOHN F. KENNEDY (CV-67), personnel from PRD Electronics and the ship's AIMD were working on a computerized MIS to provide monitoring of all components in the AIMD repair cycle. In addition to component "visibility" the new system automated material requisitioning by AIMD and squadron maintenance personnel. The initial results were promising and the USS JOHN F. KENNEDY requested installation of the system on a permanent operational basis. This was the beginning of the Status, Inventory, Data Management System (SIDMS).

With support from CNAL, ASO, NAVMAT and NAVSUP; SIDMS entered service aboard USS JOHN F. KENNEDY in the fall of 1976 and made a deployment to the Mediterranean in 1977. This first deployment of SIDMS was for the most part a concept test with SIDMS running "along side" the manual means of managing the AIMD. The hardware functioned satisfactorily but there were software difficulties which prevented SIDMS outputs from being used.

In a second deployment aboard USS JOHN F. KENNEDY in 1978, SIDMS was enhanced and subsequently performed better but this time there were hardware problems in the early stages of the cruise which detracted from full system utilization. Even with the encouraging progress that was

being made, there were some areas that were not covered by SIDMS. Although items in the repair cycle were monitored, rotable pool status, Awaiting Parts (AWP) and Not Mission Capable Supply/Partial Mission Capable Supply (NMCS/PMCS) reports all had to be produced by alternate means. As SIDMS was being developed, a supply automation system INFOREX was installed aboard other aircraft carriers. INFOREX provided these capabilities which SIDMS lacked and in August 1980 the two systems were merged, forming SIDMS II, the basis for the present system. In order to improve reliability, a Harris computer was used and the new SIDMS II deployed aboard USS JOHN F. KENNEDY to the Mediterranean in 1980/81. The results of the new system were so positive, COMNAVAIRLANT approved implementation of SIDMS II aboard all Atlantic Fleet aircraft carriers.

D. CURRENT CAPABILITIES

1. User Provisions

The following features are available to users of SIDMS II: [Ref. 10]

Assistance in ordering parts

Indication if a part is carried onboard

Maintenance of rotable pool records

Maintenance of AWP records

Tracking components in AIMD repair cycle

Provide AIMD test bench status

Maintain AIMD ICRL current status

Provide supply requisition status

Provide personnel AIMD listings

Provide PME calibration status

Provide GSE current status

Assist in making cannibalization decisions in AIMD

Provide visibility of EXREPS

Provide visibility of critical pool items

Formulate MILSTRIP messages

To make use of these features the user must enter data as it is generated. This means a shop supervisor must enter a job completion immediately after the work is done rather than at the end of the day, the end of the shift or even the next coffee break.

2. Hardware

a. Squadrons (9)

CRT and printer in each Maintenance/Material Control.

b. Supply

CRT and printer (6) in various offices/work centers. This includes a form printer in Supply Response Section for printing requisitions (DD-1348).

c. AIMD

Harris Model 100 computer, two or three disk drive units with 160-320 megabytes total storage capacity, uninterruptable power supply, two tape drives, two operator

consoles, 600 lines per minute printer for reports, paper punch, and 24 CRTs and printers in offices and work centers.

3. Software

The applications programs have been developed by Navy and PRD Electronics personnel. There are more than 35 user programs with over 100 query options. The language is COBOL (ANSI II) operating under the Harris Vulcan operating system. The TOTAL II data base management system is used by the system.

4. Data Base Development

A great deal of coordinated effort is necessary in construction of the SIDMS data base. The joint undertaking involves COMNAVAIRLANT, Fleet Material Support Office (FMSO), Naval Aviation Logistics Center (NAVAVNLOGCEN) and all the shipboard SIDMS users: AIMD, supply and the squadrons. The final tailoring of the data is done by PRD Electronics. The following data files are loaded into the SIDMS II data base prior to predeployment training cruises:

a. Aviation Consolidated Allowance List (AVCAL).

This is a listing of the aviation parts carried on board and numbers from 45,000 to 50,000 items from the Ship's Master Record File. Also included is a cross-reference from Part Number (P/N) to National Stock Number (NSN) with alternate comparable NSNs. These P/Ns and NSNs with alternates are merged by FMSO.

b. Precision Measuring Equipment (PME)

A listing of several thousand pieces of equipment which must be periodically calibrated along with the dates due for each.

c. Individual Component Repair List (ICRL)

This is a master listing of the AIMD's repair capability or just what can be fixed on board the carrier.

d. Rotable Pool

A listing of high demand repairable components or subsystems kept as spares to be issued on a one for one turn-in basis.

e. AIMD Personnel Listing

This includes special training and qualifications necessary in making effective work assignments.

f. Support Equipment (SE)

Several hundred maintenance equipment items along with their locations.

g. Technical Publications

A listing of all the technical publications maintained by AIMD in central and dispersed locations. This is most important when updates or new editions of publications are received to make sure all copies are updated.

h. Job Control Numbers (JCN)s, Parts Ordered and Status as Modified

This is the tracking of the ongoing day to day maintenance effort.

5. Products

Because of the integrated data base of source information available for the SIDMS II products, the various maintenance managers are able to make decisions on current, shared information thus helping the diverse players work as a team. The products are available as CRT displays which can be printed (screen dumped) on the dot matrix printer colocated with the CRT. Longer formal reports are produced on a 600 line per minute printer and can be output as often as managers request. The following is a functional summary of the SIDMS II products available:

a. AIMD Repair/Production Functions

Component under repair status

Work center production status

Test bench status

PME calibration information

Support equipment status

b. Supply Support/Material Functions

Automated DD-1348 requisitioning

AWP management

Rotable pool management

AVCAL supply stock information

Requisition status

NMCS/PMCS management

P/N to NSN or alt P/N information

MILSTRIP processing

c. General Management Functions

Personnel data roster

Individual Component Readiness Listing

Technical Publication location file

Support equipment file

Tracking of selected items by serial number

d. Automated Analysis and Reports

Work shift/daily production status reports

WRA/SRA production summaries

Supply status and statistical summary reports

Weekly, Monthly, End of Cruise, and End of Year reports

E. LESSONS LEARNED

One area of difficulty which appeared even when hardware and software were working properly, was that of functional knowledge, or rather lack thereof, concerning the manual system by the user. This "remedial" instruction for some of the users on the basic manual system presented an additional burden for the training personnel along with SIDMS II training per se [Ref. 9]. The training must be "team training." Functional training alone does not provide the integration aspects of a real time data base MIS involving several distinct organizations. This cooperative aspect shows up in several other ways. Input information from all sources must be timely and valid in order to attain the goal of better support and higher readiness for the airwing.

Because of the visibility and ease of accessing information which SIDMS provides, it is readily apparent when one of the players tries to make himself look good at the expense of the overall mission. There are great benefits to be gained in efficiency and effectiveness from automation but it will not eliminate personnel. The efforts of personnel can be redirected to more profitable tasks.

F. OPERATIONAL EVALUATIONS

One of the first operational evaluations was reported in a letter from COMNAVAIRLANT to CNO in April 1982 [Ref. 11]. It stated that preliminary findings concerning SIDMS indicated it had allowed AIMD and aviation supply managers to improve substantially the component processing time and supply response/delivery times of components most needed by the air wings. In addition to reducing NMCS, air wing readiness had increased and cannibalization actions had decreased. In comparing readiness statistics of SIDMS and non-SIDMS aircraft carriers, the mission capable rate was 8.2% higher and the full mission capable rate (FMC) was 12.5% higher on the SIDMS carriers.

A second operational evaluation is reported in a letter from Commanding Officer, Aircraft Intermediate Maintenance Support Office, Patuxent River, Maryland to CNO in October 1982 [Ref. 12]. The report was in response to a request from CNO to compare SIDMS and non-SIDMS CVs in the areas of

turnaround time and AWP trends, cannibalization trends, and readiness/mission capability trends. The results are summarized as follows:

1. Turnaround time (TAT) was 17% less on SIDMS carriers than on non-SIDMS carriers. Awaiting Parts (AWP) time on SIDMS carriers was 12% less than on non-SIDMS carriers.

2. Cannibalization manhours on SIDMS carriers were 8% less than on non-SIDMS carriers.

3. Readiness/Mission Capable statistics showed Mission Capable figures 5.9% higher for SIDMS carriers and Full Mission Capable (FMC) figures 8.0% higher for SIDMS carriers than non-SIDMS carriers.

G. FUTURE DEVELOPMENTS

Although SIDMS II is an interim system, the contract with Harris and PRD Electronics will keep SIDMS II on Atlantic Fleet carriers through 1985. Enhancements are still being effected in the form of Engineering Change Proposals (ECP)s.

One of the most effective ECPs that is just being incorporated interfaces SIDMS II with SUADPS, thus automating the input of SUADPS source data. This will eliminate manual source document preparation and associated key punch errors. Several other ECPs are near completion which will replace stock on a one-for-one basis as it is drawn from supply and another ECP which brings Closed Loop Aeronautical Management Plan (CLAMP) under SIDMS.

When the USS CARL VINSON (CVN-70) transferred from the Atlantic Fleet to the Pacific Fleet in 1983, the SIDMS II hardware was to be removed and sent to an Atlantic Fleet carrier. This presented a problem since the VINSON and embarked air wing did not want to give up the capabilities they had come to depend on in SIDMS. The solution, since the Navy does have proprietary rights to the SIDMS software, was to modify the SIDMS software to run on the new SNAP I Phase II (Honeywell DPS-6) hardware. This is in process now and should be installed prior to VINSON's next deployment. The success SIDMS has known in the Atlantic Fleet may soon extend to the Pacific Fleet as well.

III. NALCOMIS OVERVIEW

A. BACKGROUND

There are three organizations which directly support mission readiness of Navy aircraft; the squadron level maintenance or organizational maintenance activity (OMA), the intermediate maintenance activity (IMA) and the supply support center (SSC). Several problems have been plaguing these organizations in their efforts to maintain aircraft at an acceptably high standard of readiness [Ref. 13].

1. Lack of a single, integrated, real-time, automated MIS to support the managers at the OMA, IMA and SSC levels Navy-wide. Those aircraft carriers which don't have SIDMS are using 1960's keypunch, tape-oriented, batch processing systems which produce historical information of little use to maintenance managers for decision making.

2. Lack of automated source data entry techniques for data input by aviation maintenance and supply personnel. In order to provide the maximum number of safely-flyable, mission capable aircraft and avoid flying unsafe aircraft, all maintenance actions to the aircraft must be documented. This is done manually on source documents, known as Visual Information Display System/Maintenance Action Forms (VIDS/MAFs). At any one time there may be from 125 to 150 of these active in a squadron (OMA). The number of VIDS/MAFS in

the associated IMA will be on the order of thousands and the SSC will have on the average 1 1/2 documents for each one at the maintenance activities. What this amounts to is a tremendous amount of manual paperwork which then gets translated into data by keypunching and finally into the "baseline" computer system. The opportunity for errors in coding and lost data is quite high. Additionally the productive maintenance manhours that are devoted to manual paperwork preparation are not available for actually fixing aircraft.

3. Lack of adequate data to meet requirements of certain Navy and DOD programs. Not only does the local maintenance manager have to document actions which affect his aircraft readiness and safety but there are also requirements for data at higher echelons which are of no direct benefit to the local manager. The incompleteness and untimeliness of the data for the higher echelon requirements presents a serious problem for the baseline MIS.

The goal of Naval Aviation Logistics Command Management Information System (NALCOMIS Module 1) is to implement a modern integrated, real-time MIS to assist the managers at the OMA, IMA and SSC levels in coping with the three primary problems mentioned above. The "Module 1" identifies this phase of NALCOMIS which deals with the OMA, IMA and SSC. It is the only phase that will be dealt with in this thesis and any reference to NALCOMIS

Module 1. There may be other modules planned for the future, but none were found in searching the current literature.

B. OBJECTIVES

The specific objectives of NALCOMIS correspond to the three previously mentioned problem areas.

1. To develop a single, integrated, real-time automated standard MIS to assist aviation maintenance and material managers in their day-to-day operations and decision making

2. To develop automated source data entry techniques for use by aviation maintenance and supply personnel

3. To develop an MIS capable of supporting the upline reporting requirements of certain Navy and DOD programs at higher echelons with less impact on the base level maintenance and support functions.

C. NALCOMIS DESCRIPTION

One way to describe a complex system such as NALCOMIS is to break it down into functional subsystems. The following subsystems provide an understanding of the various functions of NALCOMIS.

1. Flight Activity Subsystem

This OMA level function will collect flight data (hours flown by aircraft and crew members) and maintain that data so that scheduled maintenance can be performed in a timely manner, aircraft logbooks can be updated, and flight time properly credited to flight crews.

2. Maintenance Activity Subsystem

Provide information to maintenance managers at the OMA and IMA level concerning scheduled and unscheduled maintenance to be performed, operational status of aircraft and maintenance equipment and current workload of any shop or workcenter.

3. Configuration Management Subsystem

Provide information as to the current configuration status of aircraft, engines, components and ground support equipment to OMA and IMA managers. Also provide information as to the incorporation or nonincorporation of technical directives (TDCs) which apply to the above equipment.

4. Maintenance Personnel Management Subsystem

Provide an up-to-date personnel roster which includes professional qualifications and training, personnel allowances and dates of gains and losses of personnel. This would help assign the right person to the right job and reveal projected personnel shortages which might be minimized with scheduled training of onboard personnel.

5. Asset Management Subsystem

Provide an inventory and accountability system for OMA and IMA managers to keep track of assigned aircraft support equipment with particular emphasis on usage, subcustody and location.

6. Supply Support Center (SSC) Subsystem

To process the demands for aviation repairables, repair parts and consumables from OMAs and IMA.

7. Local/Upline Reporting Subsystem

To capture, summarize, format and transmit up-line data concerning aviation maintenance to higher echelon commanders.

8. System Support Subsystem

The operating system, DBMS and communication utilities to enable the above subsystems to function in a real-time mode.

D. MINIMUM CAPABILITIES

The following minimum capabilities must be met by the NALCOMIS hardware and software [Ref. 1].

1. Multiprogramming capability supporting real-time applications in the foreground and batch processing in the background.

2. A monitor capability which can recognize priorities and allocate resources in response to those priorities.

3. A database management system (DBMS) which is transparent to the applications programs.

4. An ANSI-COBOL-74 compiler is required since all programs must be written in this high level language.

5. An interactive query capability to enable users to retrieve specific data quickly.

6. Security provisions to prevent unauthorized use.

7. Satisfy data reporting requirements for upline reporting.

8. Satisfy mobility requirements for Navy and Marine Corps deployable units.

9. Satisfy reliability requirements considering:

a. Vulnerability of hardware/software (including database)

b. Security of data communications both afloat and ashore.

10. Standardization of systems rather than unique locally developed systems at the OMA/IMA/SSC level.

E. ALTERNATIVE SELECTION

Several alternatives were considered to meet the objectives and minimum capabilities of NALCOMIS.

Alt 1. Keep the status quo. This was unsatisfactory because of the numerous problems already stated.

Alt 1A. Augment the baseline system but this does not meet the real-time or mobility requirements, so it was unsatisfactory.

Alt 2. Automate the source data capability but as a stand-alone alternative it was not acceptable since it did not satisfy the real-time or mobility requirements.

Alt 3. Implement standard requirements on nonstandard hardware. This alternative did not meet the mobility and system standardization criteria. It was therefore considered unsatisfactory.

Alt 4. Implement standard requirements using standard hardware and standard software. This alternative had several options.

Alt 4A. Centralized data services support, was not acceptable because of security and transmission problems between afloat and ashore activities.

Alt 4B. Regionalized data services support, was not accepted for several reasons associated with communications, the most prominent being high volume input/output applications were not cost effective for on-line processing.

Alt 4C. Localized data services support satisfied all the minimum capabilities criteria and was the favored option.

Alt 4D. Hierarchical data services support did not satisfy the security and mobility requirements and was therefore not acceptable.

Since alternative (4C), localized data services support, was the only one which met the minimum requirements, a cost/benefit analysis was made between the status quo alternative (1) and alternative (4C).

F. COSTS

The life-cycle of NALCOMIS is projected to be twenty-two (22) years with ninety-five (95) operational sites. The costs have been divided into investment and operating costs. Comparisons were made between the baseline system, alternative (1), and localized data services support, alternative

(4C). Total costs which include both investment and operating costs were calculated for each with the following results:

1. Investment

   Alt (1): $6,922,000 Alt (4C): $449,312,000

2. Operating

   Alt (1): $2,553,166,000 Alt (4C): $2,069,794,000

3. Investment and Operating

   Alt (1): $2,560,088,000 Alt (4C): $2,519,106,000

4. Escalated and Discounted to compare Net Present Values

   Alt (1): $1,542,835,000 Alt (4C): $1,619,812,000

The investment costs for Alt (4C), NALCOMIS are considerably more than the baseline status quo Alt (1); however the operating costs over the life-cycle are considerably less for Alt (4C) NALCOMIS. The total costs present a favorable comparison for NALCOMIS to the baseline in the amount of $40,982,000; however when costs are escalated in accordance with NAVCOMP memorandum of 23 July 1980 subject "Revised Pricing Guidance for FY 1982 DON Budget" and discounted in accordance with SECNAVINST 7000.14B, NALCOMIS is more costly by $76,977,000 than the baseline alternate. Even though the bottom line cost is higher for NALCOMIS, the potential benefits were felt to more than outweigh the difference in cost [Ref. 1]. A graphic representation of these cost comparisons is presented in Figure 3.1.

Summary Cost Categories-NALCOMIS Module 1.
FY1977 — FY1998

Change: 5

Date: March 1981

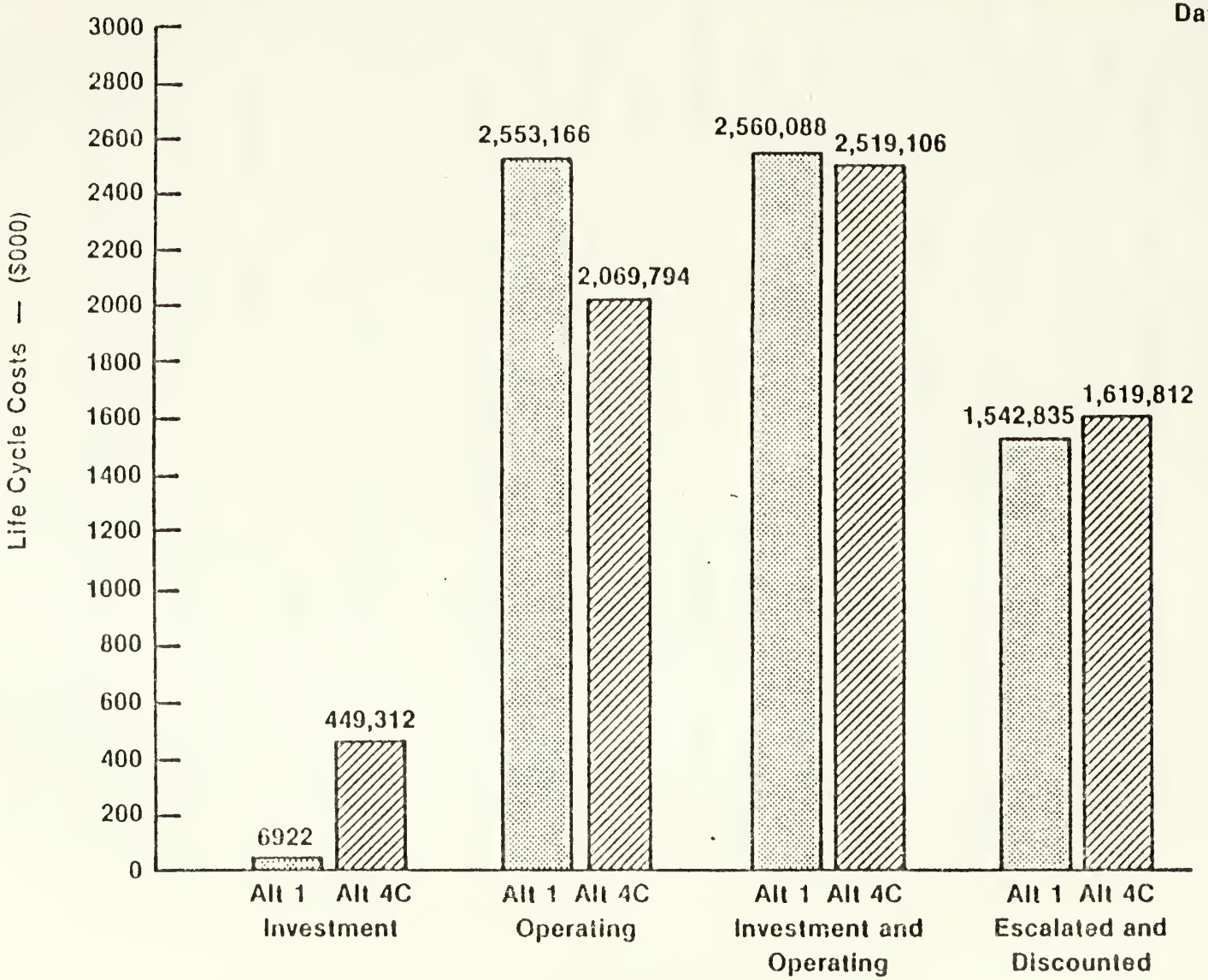

Figure 3.1

G. BENEFITS

By providing managers at the OMA, IMA and SSC level of aviation maintenance support with vastly improved management information tools in the form of NALCOMIS, there will be measurable improvement in the mission readiness capability of Navy and Marine Corps aircraft. The following are specific benefits which should be realized with the implementation of NALCOMIS:

1. Reduction of Not Mission Capable-Maintenance (NMCM) rate by a minimum of two percent (2%).

2. Reduction of Not Mission Capable-Supply (NMCS) rate by a minimum of three percent (3%). To put a monetary value on these reductions, NMCM/NMCS, a one percent (1%) decrease in both NMCM/NMCS for one year would translate to $8,748,744 in aircraft opportunity dollars.

3. Reduction of Partial Mission Capable (PMC) rate by a minimum of five percent (5%).

4. Reduction of Awaiting Maintenance (AWM) rate by a minimum of five percent (5%).

5. Reduction of approximately 2,158 man-year equivalents of technical personnel performing support functions for the baseline system. These man-years would be returned to productive maintenance functions directly supporting aircraft readiness. This translates to a potential cost avoidance of $306,328,000 for the life of NALCOMIS.

6. Reduction of supply response time by a minimum of twenty percent (20%).

7. Reduction of component Turnaround Time (TAT) by twenty percent (20%). By reducing the TAT by 20%, the fixed allowance of spare parts can be reduced by at least five percent (5%) which would result in a savings of approximately $127,961,000 over the life of NALCOMIS.

8. Reduction of Beyond the Capability of Maintenance (BCM) by five percent (5%).

9. Reduction of 305 ADP support personnel. This translates to a cost avoidance of $39,940,000 over the life of NALCOMIS.

10. Reduction of inventory loss of components by a minimum of twenty percent (20%) through improved accuracy of inventory. This would equate to a cost reduction of $134,315,500 for the life of NALCOMIS.

11. Reduction of unmatched records through integration of maintenance and supply databases.

12. Improved quality and timeliness of upline reports to Navy and DOD programs at higher echelons.

All the monetary figures are based on 1981 estimates and a 22 year life cycle for NALCOMIS.

H. NALCOMIS DESIGN MODIFICATION

The original design was based on one central processor and one central database. It was determined in 1982 that this design would not meet several of the fundamental user

requirements. A modified design which used an independent distributed database was developed using a central processor and numerous Remote Peripheral Subsystem Processors (RPS)s. The central processor would be the same SNAP I hardware as before and the (RPS)s would be minis distributed to each squadron and the IMA. Common data would be stored in the central database and data for a unique squadron or IMA would be stored at the respective RPS. A networking design would allow users to access data from any database including the central [Ref. 13].

The software was also reorganized into three Independent Functional Processes (IFP's), IFP-A for organizational level maintenance (OMA), IFP-B for intermediate level maintenance (IMA) and IFP-C for supply support center (SSC). Several advantages were possible with this modified design:

1. Flexible implementation because of the modularity of hardware and software.

2. Improved response time since the OMAs, IMA and SSC would not be competing with each other for the database on one processor.

3. Deployability, in that a squadron (OMA) would have a "stand alone" capability.

4. Fail-Soft capability in that if one of the RPS's failed, all the others and the central processor would continue to function. If the central processor failed, the RPS's would continue to function normally except for the

denial of access to data only stored in the central common database.

A large very complex project such as NALCOMIS which has been years in development and experienced a major design modification could also be attempting to meet user needs or functional requirements which have also changed.

IV. USER/FUNCTIONAL REQUIREMENTS

A. RESEARCH QUESTIONS

In addition to the primary research objective of updating the functional requirements for NALCOMIS based on inputs from experienced SIDMS users, there are five related questions that this research will endeavor to answer.

1. "What are the most important/useful functions for a naval aviation maintenance MIS?" This question is relevant not only in the development of a new system like NALCOMIS but also in the maintenance of an existing system like SIDMS. This not only applies to additions to a system but also to deletions of functions which are of little or no use to the user. The need to delete some portions of a software project can also become unavoidable when a project is behind schedule. As Brooks [Ref. 14] points out, trimming the task is one of the alternatives when a software project falls behind schedule and the only feasible action when secondary costs are high. Since NALCOMIS is behind schedule already, knowing what functions are most or least important to the user may indicate which portions of the system to trim should this become necessary.

In order to determine what the most important/useful functions were from a user perspective, a questionnaire was developed with thirty-nine items drawn from the functional

requirements of SIDMS [Ref. 10] and NALCOMIS [Ref. 1]. Experienced users of SIDMS were asked to complete the questionnaire and in so doing rate all items on a scale of importance/usefulness from A to E; A being most important/useful and E being least important/useful. The rating scale was taken from the US Army Questionnaire Construction Manual [Ref. 7]. After rating each item, the respondents were asked to rank the top five items. This was included to differentiate those items at the upper end of the scale and also as a consistency check of the ratings on the 39 items. A complete questionnaire can be found in Appendix A.

2. "What were the major advantages of an MIS over previous manual methods?" This question was the first one asked on the interview form.

3. "What are the primary information needs an MIS should provide to a naval aviation maintenance manager?" This was the second question on the interview form. Numerous items on the questionnaire also help answer this question.

4. "What are the primary reporting requirements an MIS should provide for upline reporting?" The third question on the interview along with some items on the questionnaire covered this question.

5. "What were the lessons learned by users from the interim system, SIDMS?" This question was addressed in [Ref. 9] and one of the interview questions asked what problems were encountered with SIDMS.

B. DATA COLLECTION METHODOLOGY

In order to collect data in a standardized manner to answer the research questions, two data collection vehicles were developed, a questionnaire and an interview form. The respondents were not identified by name or social security number, thus eliminating Privacy Act restrictions. Reference data were collected on the respondents concerning experience level with SIDMS (the number of months they had used SIDMS) and the command and billet in which the SIDMS experience had been gained. These three elements insured the respondent was an operational user of SIDMS and the duration of his exposure to the system was significant. The instructions provided the respondent a brief background and purpose of the questionnaire. They also requested the respondent to mark all items and if the item did not apply or there was no opinion to mark "C." This corresponded to a "neutral" response. At the end of the questionnaire items, the respondent was asked to rank the top five most important/useful items. This would further refine those items which might have all been rated "A" on the scale. At the end of the questionnaire respondents were asked for comments/recommendations and any significant items which were not previously mentioned.

The interview consisted of six structured questions and also identified the respondent only by number of months experience on SIDMS, command and billet when using SIDMS

operationally. No names or social security numbers were collected.

C. SAMPLE SELECTION/QUALIFICATIONS

One of the prime validity considerations was that all members sampled must have been an operational user of SIDMS. Because Norfolk, Virginia is the home of COMNAVAIRLANT, home port of most of the Atlantic Fleet aircraft carriers and embarked squadrons, the availability of experienced SIDMS users was higher there than any other location. A research trip was arranged with the assistance of Navy Management Systems Support Office (NAVMASSO) and COMNAVAIRLANT. During a one week visit to Norfolk by the researcher, users were interviewed and questionnaires completed.

Since the respondents were not selected in a truly random manner, i.e. using a random number table and selecting from the entire SIDMS user population, the results of any statistical test can only be applied to the sample itself. Because many of the SIDMS users were aboard deployed aircraft carriers, hence not reachable for interview and the delay for questionnaire completion would have been considerable, a "judgement sample" was taken in the Norfolk, Virginia area from the three main user groups; AIMD, aviation supply, and squadron maintenance.

The qualifications of those surveyed were quite impressive. The sample included three AIMD department heads,

one assistant AIMD department head, three AIMD production control chief petty officers, two aviation supply officers, one aviation supply chief petty officer, two air wing maintenance officers, one squadron assistant maintenance officer and one squadron maintenance material control officer. These were not all those sampled, but an indication of their experience level in the Navy. The mean number of months experience using SIDMS for the entire sample was 18.3 months.

D. STATISTICAL ANALYSIS

The sample consisted of twenty-three respondents to the questionnaire and interview. Since this is less than thirty, this is considered a "small sample" for statistical analysis purposes. In order to quantify the responses to the thirty-nine items on the questionnaire, numerical values were assigned the letters used to rate each item on importance/usefulness. The highest rating, "A. Very important, extremely useful" was assigned a value of five (5). "B. Important, of considerable use" was assigned a value of four (4). "C. Neutral, of use" was assigned a value of three (3). "D. Not important, not very useful" was assigned a value of two (2) and "D. Very unimportant, of no use" was assigned a value of one (1). Using these values the mean ($\bar{x}$) and standard deviation (s) were calculated for each of the

thirty-nine items on the questionnaire. Formulas for mean ($\bar{x}$) and standard deviation (s) were calculated for each of the thirty-nine items on the questionnaire. Formulas for mean ($\bar{x}$) and standard deviation (s) are below.

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} \qquad s = \sqrt{\frac{\sum_{i=1}^{n} x_i^2 - n\bar{x}^2}{n-1}}$$

Knowing the mean and standard deviation of the sample gives us an idea of the relative importance/usefulness of an item; the higher the mean, the more important/useful it was to the respondents.

Near the end of the questionnaire, the respondent is asked to rank the top five items. For this ranking a tabulation of items and their frequencies was made. In order to weight the rankings, a point value was assigned, five (5) for a first place, four (4) for a second place, three (3) for a third place, two (2) for a fourth place and one (1) for a fifth place. The weighted point totals for each item ranked were tallied and displayed to see how they compared to the mean item score distribution.

E. DATA PRESENTATION--QUESTIONNAIRE

Portions of the questionnaire are presented here in order to relate the statistics to the actual item more easily. The questionnaire in its entirety as presented to respondents is found in Appendix A. The item mean and

standard deviation are presented below for each item and the actual respondents' selections are tallied in order not to lose any information as to the distribution of marks for an item.

Billet
Command
SIDMS use in months
$\bar{x}$=18.347 s=6.285

NALCOMIS
Functional Requirements
Update

The purpose of this questionnaire is to update the user requirements for the Naval Aviation Logistics Command Management Information System (NALCOMIS) based on inputs from personnel experienced in the use of Status Inventory Data Management System (SIDMS). It is most important that the person answering the questionnaire be an experienced SIDMS user, i.e. Maintenance Officer, Maintenance Material Control Officer or Maintenance CPO.

Rate each of the following items in terms of its important/usefulness to you as a maintenance manager. Some of the items are not part of SIDMS but are part of NALCOMIS. Please mark all items. If you have no opinion on an item, mark it "C" Neutral.

Rating scale of importance/usefulness		Numerical values
A. Very important, extremely useful	=	5
B. Important, of considerable use	=	4
C. Neutral, of use	=	3
D. Not important, not very useful	=	2
E. Very unimportant, of no use	=	1

		$\bar{x}$	s
1.	Paper printout of video terminal display	4.478 A=12 B=10 C=1	0.593

		$\bar{x}$ s
2.	Reports (paper only) NORS, work stoppage	4.956 0.208 A=22 B=1
3.	Ordering parts	4.652 0.647 A=17 B=4 C=2
4.	Checking status of ordered parts	4.609 0.722 A=16 B=6 D=1
5.	AVCAL availability	4.130 0.869 A=9 B=9 C=4 D=1
6.	Teching part numbers	4.348 0.775 A=12 B=7 C=4
7.	AIMD (ICRL) repair capability	4.478 0.790 A=15 B=4 C=4
8.	Display outstanding documents by BUNO	3.869 0.920 A=7 B=7 C=8 D=1
9.	Rotable pool status	4.522 0.790 A=16 B=3 C=4
10.	EXREP JCN status	4.478 0.790 A=14 B=7 C=1 D=1
11.	AIMD test bench/support equipment status	4.043 0.878 A=9 B=6 C=8
12.	PME calibration dates	3.478 0.947 A=3 B=8 C=10 D=1 E=1
13.	Message passing between terminals	2.956 1.147 A=3 B=3 C=9 D=6 E=2
14.	Monthly summary report generation	3.699 0.876 A=5 B=7 C=10 D=1
15.	End of cruise statistics	4.174 0.937 A=11 B=6 C=5 D=1
16.	ETR/XRAY message reports	3.261 0.752 A=2 B=4 C=15 D=2

		$\bar{x}$ s
17.	VIDS/MAF automation (document initiation updating, sign-off & data storage)	4.000 1.000 A=9 B=7 C=5 D=2
18.	Flight activity data (flt hours, landings, cat shots, etc. stored)	3.217 1.085 A=3 B=5 C=11 D=2 E=2
19.	A/C statistical data	3.130 0.869 A=1 B=6 C=12 D=3 E=1
20.	Maintenance personnel data (NECs, schools PRD)	3.391 0.839 A=1 B=10 C=10 D=1 E=1
21.	Support equipment status (Condition and number units)	3.739 0.810 A=4 B=10 C=8 D=1
22.	Scheduled maintenance by A/C	3.478 0.947 A=5 B=3 C=13 D=2
23.	Operational status of each A/C (FMC/PMC)	3.696 1.019 A=7 B=4 C=10 D=2
24.	Configuration status of each A/C (Mods, TDCs incorporated)	3.217 1.042 A=3 B=4 C=13 D=1 E=2
25.	Workload by squadron workcenter	3.348 1.041 A=3 B=7 C=10 D=1 E=2
26.	A/C scheduling decision aid (Matching A/C to mission)	2.956 0.976 A=1 B=4 C=14 D=1 E=3
27.	Cannibalization decision aid (Supply/ pool availability/Exrep status)	4.478 0.730 A=14 B=6 C=3
28.	SIDMS overall usefulness	4.826 0.387 A=19 B=4
29.	Rapid computer response (less than 10 sec)	4.565 0.590 A=14 B=8 C=1
30.	Screen prompts/help functions	4.391 0.783 A=13 B=6 C=4

		$\bar{x}$	s
31.	User training (Initial & recurrent)	4.435	0.662
		A=12 B=9 C=2	
32.	Integrated data base (all users working from same data)	4.652	0.647
		A=17 B=4 C=2	
33.	Real time reports/displays	4.739	0.541
		A=18 B=4 C=1	
34.	EXREP Status report	4.739	0.619
		A=19 B=2 C=2	
35.	Pool Status report	4.565	0.662
		A=15 B=6 C=2	
36.	Pool Critical report	4.696	0.635
		A=18 B=3 C=2	
37.	Awaiting Parts report	4.696	0.635
		A=18 B=3 C=2	
38.	Production Control Status report	4.304	0.703
		A=10 B=10 C=3	
39.	NMCS/PMCS report	4.565	0.728
		A=16 B=4 C=3	

The mean of the means was 4.101 and standard deviation of means was 0.597. A graphic display of the item means can be found in Figure 4.1.

Of the above 39 items, the respondents were asked to list the top five (5) most useful/important items by number. The following is a summary of those items ranked in the top five along with the point totals for each item, five points for a number one rank, four points for a number two, three points for a number three, two points for a number four and one point for a number five rank.

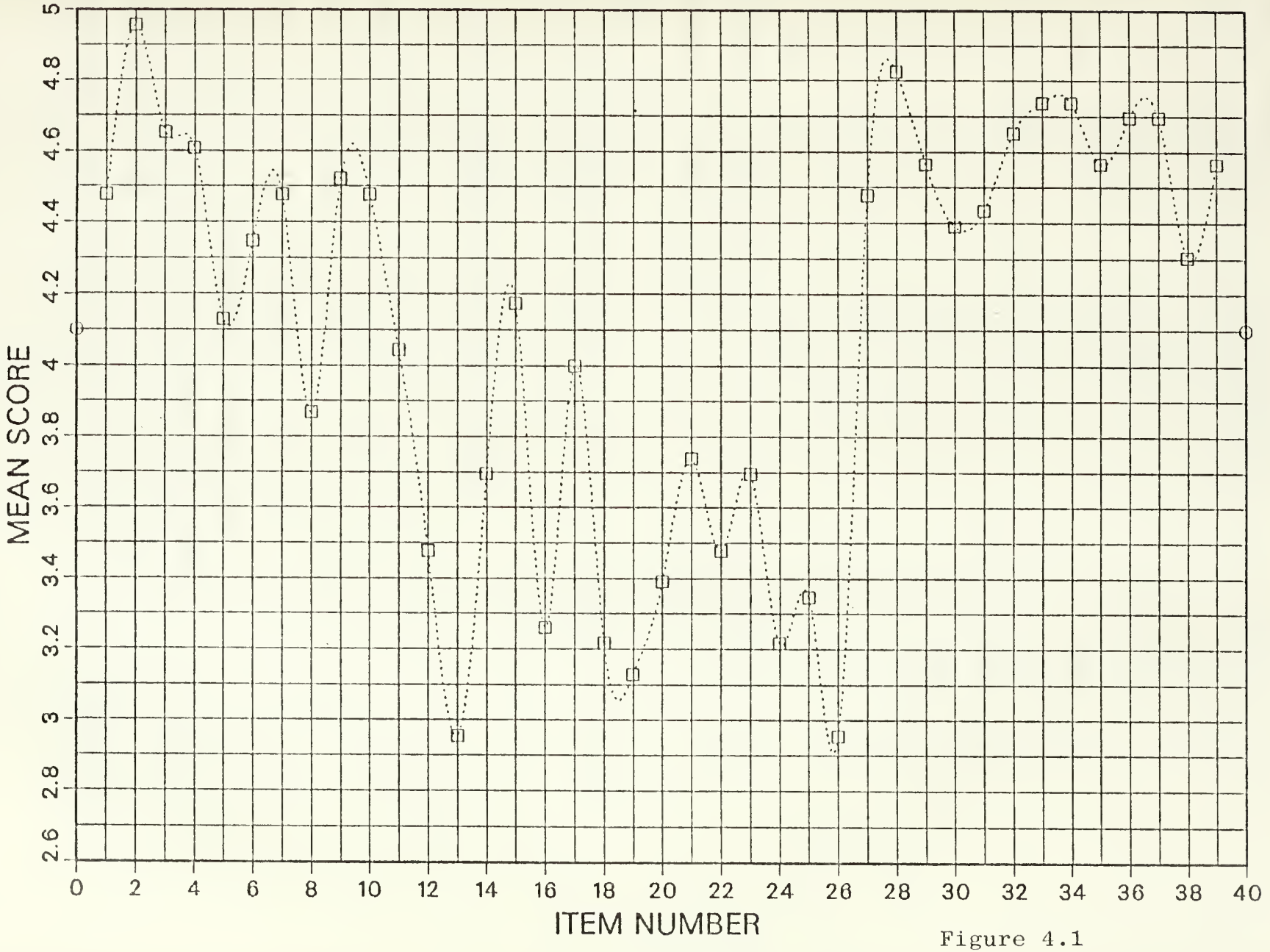
QUESTIONNAIRE
MEAN SCORE
5
4.8
4.6
4.4
4.2
4
3.8
3.6
3.4
3.2
3
2.8
2.6
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
ITEM NUMBER

Figure 4.1

Item #--Points	Item #--Points	Item #--Points
1. 12	2. 11	3. 22
4. 25	5. 5	6. 29
7. 20	8. 3	9. 7
10. 4	11. 7	14. 3
15. 5	16. 1	17. 8
20. 1	22. 2	27. 12
28. 10	29. 1	30. 3
32. 19	33. 34	34. 34
35. 12	36. 27	37. 17
38. 3	39. 8	

A graphical representation of the "top five rated" items according to their respective point totals may be found in Figure 4.2.

A more quantitative view of the mean ratings of the 39 questionnaire items is portrayed in Figure 4.3.

F. DATA INTERPRETATION--QUESTIONNAIRE

The graphic representations of the individual item means in Figure 4.1 and the frequency distribution of the item means in a histogram, Figure 4.3, are perhaps the most helpful method to visualize and interpret the data from the questionnaire. Since the items were drawn from the existing functional requirements of SIDMS and NALCOMIS, the rather high "mean of the means" statistic of 4.101 was not unexpected. To determine which items were rated highest and

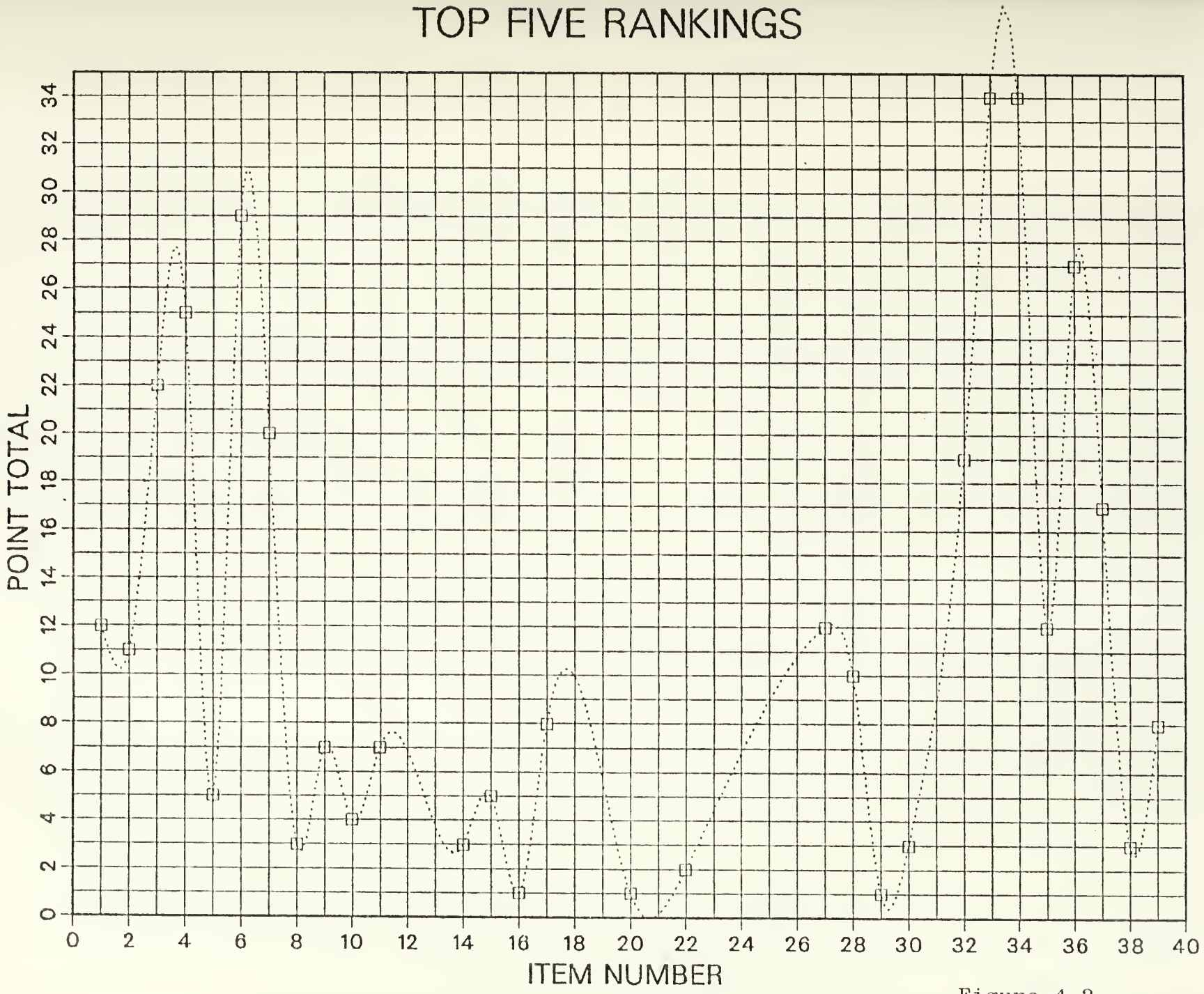
TOP FIVE RANKINGS
POINT TOTAL
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34
ITEM NUMBER
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40

Figure 4.2

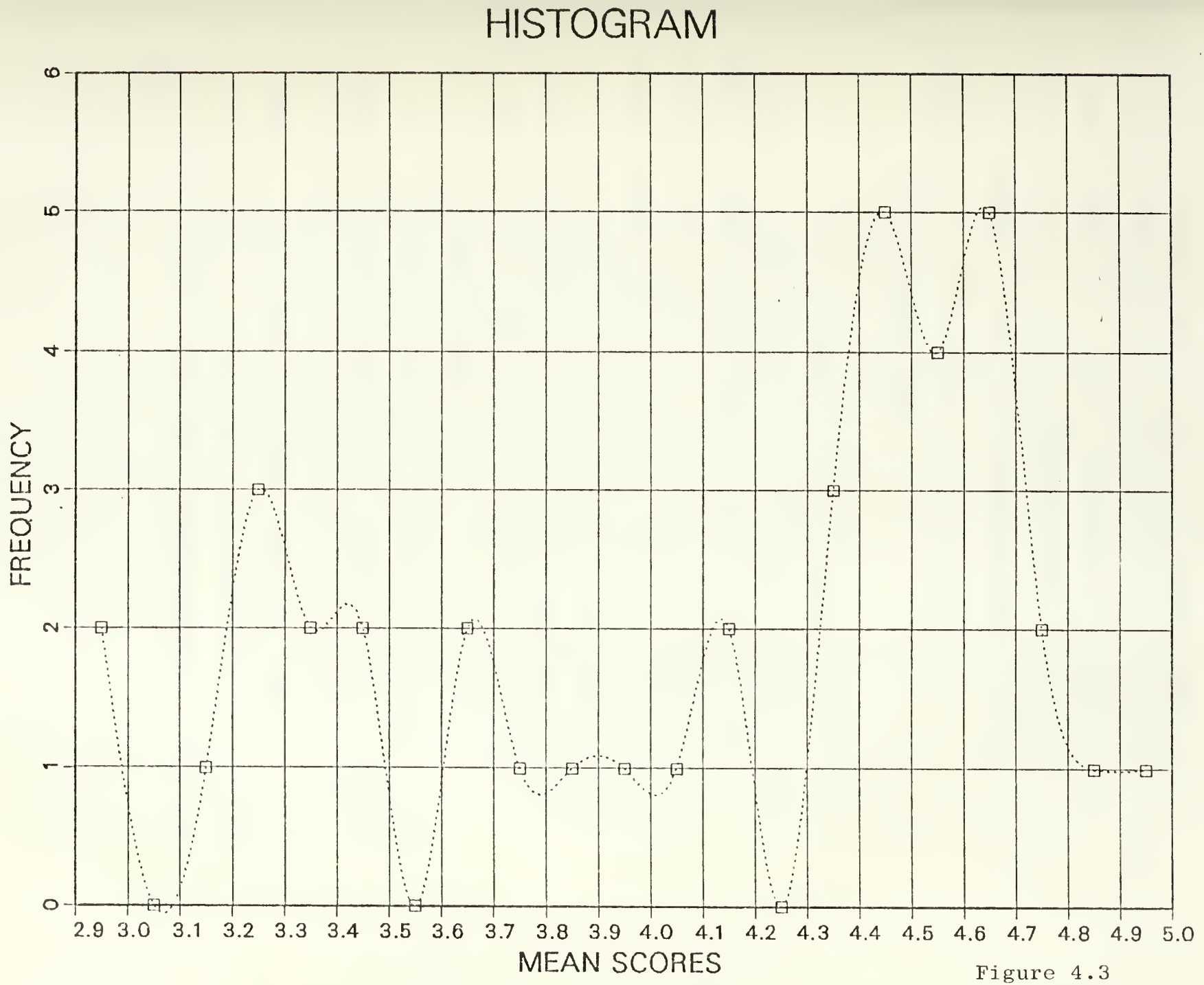
HISTOGRAM
FREQUENCY
0
1
2
3
4
5
6
2.9 3.0 3.1 3.2 3.3 3.4 3.5 3.6 3.7 3.8 3.9 4.0 4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9 5.0
MEAN SCORES

Figure 4.3

lowest, a close inspection of the frequency distribution depicted in Figure 4.3 reveals two distinct "clusters." The "higher cluster" of items is centered at 4.55 and extends from 4.3 to 5.0. Those items whose mean rating placed them in the "higher cluster" are presented below according to the categories general, supply, AIMD and squadron.

1. Above Average Items

a. General Items

The availability of paper printouts of video displays and more extensive formal paper reports (Items 1 and 2). Overall usefulness of SIDMS (Item 28). Rapid response time (Item 29). User friendliness in the form of screen prompts and help functions (Item 30). Both initial and recurrent user training (Item 31). All users working from the same data in the form of an integrated database (Item 32). Real-time reports and displays (Item 33).

b. Supply Items

Ordering parts and checking their status (Items 3 and 4). Cross-referencing part numbers to stock numbers (Item 6). What parts are available in the rotable pool (Item 9). Reports which indicate status of the rotable pool (Items 35 and 36). Reports on what subsystems and aircraft are awaiting supply parts, AWP and NMCS/PMCS (Items 37 and 39).

c. AIMD Items

The repair capability of the AIMD, ICRL (Item 7). The status of a part in repair at AIMD (Items 10 and 34). Cannibalization decision aid (Item 27). What the backlog of each shop in AIMD is (Item 38).

d. Squadron Items

Aircraft cannibalization decision aid (Item 27).

2. Below Average Items

The "lower cluster" of item mean ratings was centered at 3.25 and ranged from 2.9 to 3.5. The items are grouped below according to categories general, AIMD/Squadron, and Squadron.

a. General Items

Message passing between terminals (Item 13).

b. AIMD/Squadron Items

Precision Measuring Equipment (PME) calibration dates (Item 12), ETR/XRAY message reports (Item 16), and Maintenance personnel data (Item 20).

c. Squadron Items

Flight activity data (Item 18), Aircraft statistical data (Item 19), Scheduled maintenance by A/C (Item 22), Configuration status of each A/C (Item 24), and Aircraft scheduling decision aid (Item 26).

G. DATA PRESENTATION--INTERVIEW

The questions from the interview are presented here along with the responses given. Responses were categorized

and tallied for each question. The responses appear in order of frequency mentioned with the frequency if mentioned more than once in brackets. The interview as presented to the interviewee can be found in Appendix B.

"1. What were the major advantages of a computer management information system (SIDMS) over previous manual methods?

Rank these in order of importance."

Real-time status of work, setting priorities (8)

Real-time supply information, pool status, AVCAL (6)

Real-time information, other (5)

Common database (5)

Cannibalization aid (4)

Rotable pool visibility (3)

Teching part numbers and alternates (3)

Saving time, general

Less lost data

Error checking on data entry

Part location

Better equipment (SRA) tracking

Increased production, improved processing efficiency

Historical parts usage data

Report flexibility

Standardization of management techniques

Monitor production

Track work center trends, backlogs

Interface between supply and squadrons

Fast communication

"2. What are the primary information needs a MIS should provide to a maintenance manager?"

Rotable pool critical report (12)

NMCS/PMCS report (11)

EXREP status report (10)

AWP report (9)

Test bench status report (3)

AIMD production status report (2)

Cannibalization report

AIMD units under repair report

Rotable pool status report

NIS listing

Track SRAs and match to WRAs

PME calibration report

ICRL report

*All information must be readily available and real-time to manage effectively.

*3M reports presently too late to be valuable.

"3. What are the primary reporting requirements a MIS should provide for a maintenance manager?"

Aircraft material readiness report, AMRR (8)

End of cruise/operating period report (6)

(Usage data for AVCAL update by NSN & A/C)

Test bench down "Broad-Arrow" report (3)

Engine transaction report ETR

Situation summary report

MILSTRIP messages

Rotable pool report, biweekly

ASCC reconciliation report

AIMD daily production report

Supply response time end of month report

Xray reports

OPTAR accounting/reporting

*These reports can be handled in a batch mode for the most part vice real-time.

"4. What were the best features of SIDMS which should be part of any follow-on system?"

Real-time information to all maintenance activities (5)

Common (integrated) database (4)

AWP visibility (3)

Rapid response time (3)

Interactive real-time database (2)

Real-time EXREP status (2)

NMCS/PMCS (2)

Teching P/N to alternates and NSN (2)

Parts ordering (2)

Ease of use/user friendly (2)

Reliability/Maintainability (2)

Pool management, visibility to see needs and assets to set work priorities

End of cruise reconciliation

AVCAL availability

Easy to understand display and reports

Technical publication library

Print out capability

Tracking supply document numbers to aircraft BUNOs

*Separate information needed by manager to make decisions from history information

*Too much security creates "bottlenecks," system must be convenient for user.

"5. What enhancements should be added to make the follow-on to SIDMS even more useful?"

Receipt processing, parts-on-hand balance (3)

Interface between SIDMS and SUADPS to supply demand data directly (2)

A/C status board display, side #, mission capability remarks

Scheduled maintenance display, side #, hrs till phase, engine, tailhook change

Status of EXREP SRA against parent WRA

Ability to show cannibalization

Supply requisition status from ASO

IMRL degradation by P/N for each test bench

More terminals, 60

Squadron programs and storage, calculate A/C weight & balance

Good user manual for NALCOMIS

JCN history, status and when changed

Reports need to go back to last time run not just back 24 hours

Automatic report generation of ETR's, Xray's and Broad-Arrow

*Don't need to automate VIDS/MAF

*Don't need more for AIMD

"6. What were the worst problems with SIDMS which should be corrected in any follow-on system?"

Down time, not frequent, but a real problem when it happened (3)

Organic maintainability of hardware and software (2)

Long daily backup time (2)

Personnel file inadequate, format & security (2)

Late user inputs

SIDMS under AIMD control

Slow hard-copy reports, 4 hrs/day

Responsive liason between knowledgeable users and programmers

Terminal security, knowing which terminal entered data

More and better user training

Long restore time when system malfunctions

Not enough terminals, need three more for supply

No shore systems like SIDMS

User input errors difficult to correct

*Concern that NALCOMIS will try to do too much maintenance management

H. DATA INTERPRETATION--INTERVIEW

The six questions of the interview examine the management information system from several related perspectives. The first question is rather general and asks about the advantages of an MIS over manual methods. The second question is more specific in what the MIS should provide in the way of incoming information to the user. The third question addresses the outgoing reports and information he must provide to others through the MIS. The fourth question asks what were the best features of SIDMS. The fifth question asks what enhancements should be added and the sixth question asks what were the worst things about SIDMS. Since the questions are related it would seem a number of the answers would be related. This was, in fact, the case in questions one, two and four. Common threads running through responses to these three questions were "real-time, integrated database and visibility." The following is a more in-depth look at each question and the most frequent responses.

1. The major advantages of a computer management information system (SIDMS) over manual methods were real-time status of work in setting priorities (AIMD). Real-time

status was also frequently mentioned with supply information, pool status and AVCAL. Working from a common database so all players were using the same information. As a cannibalization aid for both AIMD and squadrons. Teching part numbers to alternates and NSNs from both AIMD and squadrons.

2. The primary information needs for maintenance manager were helping AIMD set work priorities through the pool critical report, EXREP status report, production status report, test bench status report and AWP report. Supply was provided information on where parts were needed most with the NMCS/PMCS report and AWP report. The air wing was particularly interested in the NMCS/PMCS report and the pool critical report.

3. Reporting requirements to others that should be met by an MIS were the Aircraft Material Readiness Report AMRR, End of Cruise/Operating period report and test bench inoperative "Broad-Arrow" report.

4. The best features of SIDMS were felt to be similar to responses in question one; real-time for all users, rapid response, common database, interactive database, AWP visibility, NMCS/PMCS, teching part numbers to alternates and NSNs, user friendliness, and reliability/maintainability.

5. Enhancements that were felt needed by SIDMS included a supply receipts processing capability which would keep an "on-hand" belance of parts carried and a SIDMS interface

with SUADPS to supply demand data directly. This last response regarding SUADPS is in processing and may be complete by now.

6. The worst problems with SIDMS were indicated as follows: system down time although infrequent created real problems for the users, lack of organic maintainability of SIDMS hardware and software, lengthy backup time daily (2 hrs) and inadequate personnel file in format and security.

Only those responses which were mentioned more than once were covered here in the interpretation section; however, that does not mean that single responses are not valid. Many of the single responses were well thought out and should be considered by anyone interested in improving SIDMS or NALCOMIS. As mentioned earlier, the common threads of real-time, integrated database and visibility appear in several question responses and in many related forms.

V. CONCLUSIONS/RECOMMENDATIONS

A. CONCLUSIONS

To present conclusions in an organized manner, they will be addressed in terms of the individual thesis research questions and supported by data as documented in Chapter IV.

1. The most important/useful functions for a naval aviation maintenance MIS from a user point of view are:

   a. General Functions

      (1) real-time reports and CRT displays

      (2) rapid response time

      (3) screen prompts and help functions (user friendly

      (4) user training, initial and recurrent

      (5) common/integrated database

   b. Supply Functions

      (1) ordering, teching and checking status of parts

      (2) rotable pool status

      (3) mission critical parts on order (NMCS/PMCS)

   c. AIMD Functions

      (1) repair capabilities of AIMD, ICRL

      (2) status of parts in repair at AIMD

      (3) cannibalization and work scheduling decision aid

d. Squadron Functions

(1) aircraft cannibalization decision aid

2. The major advantages of an MIS over previous manual methods are:

a. real-time work and supply status

b. common database

c. decision aid for cannibalization

d. visibility of rotable pool status

e. teching supply part numbers

All of these "major advantages" also appear as "most important/useful functions" in the previous question. These common conclusions only reinforce their reliability.

3. The primary information needs an MIS should provide to a naval aviation maintenance manager take the form of the following reports:

a. Pool Critical report

b. NMCS/PMCS report

c. EXREP report

d. AWP report

e. Test Bench Status report

f. AIMD Production Status report

In each of the above reports, the information is time critical since it is to be used in management decision making. The real-time aspect of the MIS is again revealed.

4. The primary requirements an MIS should provide for upline reporting are:

a. Aircraft Material Readiness Report (AMRR)

b. End of Cruise/Operating Period Report

c. Test Bench Inoperative (Broadarrow) Report

5. The lessons learned by users from the interim system, SIDMS were:

a. The implementation process for a computerized MIS is painful even when the hardware and software are working properly. Once users accept the system and depend on it, even short periods of nonavailability due to malfunction or planned maintenance create problems for the users in reverting to the manual system until the MIS is back on line. For these reasons a highly reliable system is necessary with organic maintainability for the hardware.

b. Team training for all users from the airwing, AIMD and supply team is necessary in order to achieve optimal use of the integrated database and let each member see how his input contributes to others and how their inputs contribute to his, resulting in mutual benefits.

c. Improved mission readiness was proved in operational evaluations which compared SIDMS carriers to non-SIDMS carriers. The following goals for improvement under NALCOMIS are compared to the operational evaluation results for SIDMS:

NALCOMIS		SIDMS		
Improvement Goal		Op Eval Results	1st	2nd
NMCM	2%	MC	8.2%	5.9%

NMCS	3%			
PMC	5%	PMC	12.5%	8.0%
TAT	20%	TAT		17%

The Op Evals indicated mission readiness improvements double the minimum NALCOMIS desired improvement and within 3% of component turn around time (TAT) goal. This operational comparison substantiates the contribution an aviation maintenance MIS can make toward mission readiness.

B. RECOMMENDATIONS

Based on the conclusions presented above, the following recommendations are set forth in order of priority:

1. Because of the positive response to SIDMS from operational users and demonstrated improvement in readiness shown in operational evaluations, SIDMS should be implemented Navy wide on all aircraft carriers. SIDMS is a viable, proven and available system.

2. Since NALCOMIS is such a large, multifaceted system which encompasses virtually all of the functional requirements addressed in this thesis, initial implementation efforts should be focused on those specific functional requirements which were deemed most important by users. These requirements are highlighted in the previous "Conclusions" section and discussed in detail in Chapter IV. In taking this focused approach to NALCOMIS implementation, the current users of SIDMS will not lose the benefits they now enjoy while NALCOMIS is being implemented.

3. If some parts of NALCOMIS are delayed or deleted, lower priority should be given to implementing those items which rated lower in importance/usefulness. These lower rated items are depicted in the "lower cluster" of Figure 4.3 and discussed specifically in Chapter IV.F.2. "Below Average Items."

The overall value of the maintenance management information system has been proven operationally and this thesis has indicated, based on user input, how best to implement this MIS tool in an effective and efficient manner.

LIST OF REFERENCES

1. Naval Air Systems Command, NALCOMIS Module 1 Automated Data Systems Development Plan, Change 5, 31 March 1981.

2. Roach, John C., and Genovese, Dennis H., "Aircraft Maintenance and the Paper Chase," Naval Institute Proceedings, December 1983, pp. 116-119.

3. Boston, Glenn J., NALCOMIS and the Aviation Maintenance Analyst, Master's Thesis, Naval Postgraduate School, Monterey, CA, 1979.

4. Rodenbarger, Syd W., A Functional Comparison of the Naval Aviation Logistics Command Management Information System (NALCOMIS) and the Shipboard Uniform Automated Data Processing System-Real Time (SUADPS-RT), Master's Thesis, Naval Postgraduate School, Monterey, CA 1982.

5. Bennett, John L., Building Decision Support Systems, Reading, Massachusetts, Addison-Wesley Publishing Company, 1983, p. 116.

6. O'Brien, James A., Computers in Business Management, Homewood, Illinois, Richard D. Irwin, Inc.,1982, pp. 522-523.

7. U.S. Army Research Institute for the Behavioral and Social Sciences, Questionnaire Construction Manual, September, 1976.

8. Kroenke, David M., Database Processing: Fundamentals, Design, Implementation, Second Edition, Chicago, Science Research Associates, Inc., 1983, pp. 22-38.

9. Braman, Frederick, A., "Status, Inventory Data Management System, (SIDMS II), Automation in Aviation Support Management," Mech, Winter 1982, pp. 16-21.

10. Commander Naval Air Force, U.S. Atlantic Fleet, Status Inventory Data Management System (SIDMS II), Desk Top Guide, Change 1, 30 November 1982.

11. Commander Naval Air Forces, U.S. Atlantic Fleet, Letter Serial 533/4963 to Chief of Naval Operations, Subject: Status, Inventory, Data Management System (SIDMS) Effect on Deployed CVW Readiness: Report of, 30 April 1982.

12. Commanding Officer, Aircraft Intermediate Maintenance Support Office, Patuxent River, Maryland, Letter JRS:mcf/4790 Serial 82-363 to Chief of Naval Operations (OP-514), Subject: Status, Inventory, Data Management System (SIDMS) effect on deployed Carrier Air Wing (CVW) readiness, 4 October 1982.

13. Naval Air Systems Command, Requirements Statement, NALCOMIS Module 1, NAVAIR Document Number RS-01, 15 April 1982.

14. Brooks, Fredrick P. Jr., The Mythical Man-Month, Reading, Massachusetts, Addison-Wesley Publishing Co., 1975.

APPENDIX A

QUESTIONNAIRE

Billet

Command

SIDMS use in months

NALCOMIS
Functional Requirements
Update

The purpose of this questionnaire is to update the user requirements for the Naval Aviation Logistics Command Management Information System (NALCOMIS) based on inputs from personnel experienced in the use of Status Inventory Data Management System (SIDMS). It is most important that the person answering the questionnaire be an experienced SIDMS user, i.e. Maintenance Officer, Maintenance Material Control Officer or Maintenance CPO.

Rate each of the following items in terms of its importance/usefulness to you as a maintenance manager. Some of the items are not part of SIDMS but are part of NALCOMIS. Please mark all items. If you have no opinion on an item, mark it "C" Neutral.

Rating scale of importance/usefulness

A. Very important, extremely useful

B. Important, of considerable use

C. Neutral, of use

D. Not important, not very useful

E. Very unimportant, of no use

1.	Paper printout of video terminal display	A B C D E
2.	Reports (paper only) NORS, work stoppage	A B C D E
3.	Ordering parts	A B C D E
4.	Checking status of ordered parts	A B C D E
5.	AVCAL availability	A B C D E

6.	Teching part numbers	A B C D E
7.	AIMD (ICRL) repair capability	A B C D E
8.	Display outstanding documents by BUNO	A B C D E
9.	Rotable pool status	A B C D E
10.	Exrep JCN status	A B C D E
11.	AIMD test bench/support equipment status	A B C D E
12.	PME calibration dates	A B C D E
13.	Message passing between terminals	A B C D E
14.	Monthly summary report generation	A B C D E
15.	End of cruise statistics	A B C D E
16.	ETR/XRAY message reports	A B C D E
17.	VIDS/MAF automation (document initiation updating, sign-off & data storage)	A B C D E
18.	Flight activity data (flt hours, landings cat shots, etc. stored)	A B C D E
19.	A/C statistical data	A B C D E
20.	Maintenance personnel data (NECs, schools PRD)	A B C D E
21.	Support equipment status (Condition and number units)	A B C D E
22.	Scheduled maintenance by A/C	A B C D E
23.	Operational status of each A/C (FMC/PMC)	A B C D E
24.	Configuration status of each A/C (Mods, TDCs incorporated)	A B C D E
25.	Workload by squadron workcenter	A B C D E
26.	A/C scheduling decision aid (Matching A/C to mission)	A B C D E
27.	Cannibalization decision aid (Supply/pool availability/Exrep status)	A B C D E
28.	SIDMS overall usefulness	A B C D E

29.	Rapid computer response (less than 10 sec)	A B C D E
30.	Screen prompts/help functions	A B C D E
31.	User training (Initial & recurrent)	A B C D E
32.	Integrated data base (all users working from same data)	A B C D E
33.	Real time reports/displays	A B C D E
34.	EXREP Status report	A B C D E
35.	Pool Status report	A B C D E
36.	Pool Critical report	A B C D E
37.	Awaiting Parts report	A B C D E
38.	Production Control Status report	A B C D E
39.	NMCS/PMCS report	A B C D E

Of the above 39 items, list the top five (5) most useful/important items by number.

a. b. c. d. e.

Which personnel were the primary users of SIDMS by billet?

Any important items not previously mentioned or general comments/recommendations?

APPENDIX B

INTERVIEW

SIDMS experience in months ( )

Command

Billet

1. What were the major advantages of a computer management information system (SIDMS) over previous manual methods? Rank these in order of importance.

2. What are the primary information needs a MIS should provide to a maintenance manager?

3. What are the primary reporting requirements a MIS should provide for a maintenance manager?

4. What were the best features of SIDMS which should be part of any follow-on system?

5. What enhancements should be added to make the follow-on to SIDMS even more useful?

6. What were the worst problems with SIDMS which should be corrected in any follow-on system?

INITIAL DISTRIBUTION LIST

		No. Copies
1.	Defense Technical Information Center Cameron Station Alexandria, Virginia 22314	2
2.	Library, Code 0142 Naval Postgraduate School Monterey, California 93943	2
3.	Department Chairman, Code 54 Department of Administrative Sciences Naval Postgraduate School Monterey, California 93943	1
4.	Professor Daniel R. Dolk, Code 54Dk Department of Administrative Sciences Naval Postgraduate School Monterey, California 93943	1
5.	CDR Dean C. Guyer, SC, USN, Code 54Gu Department of Administrative Sciences Naval Postgraduate School Monterey, California 93943	1
6.	Curricular Officer, Code 37 Computer Technology Programs Naval Postgraduate School Monterey, California 93943	1
7.	CAPT William H. Rush, USN Commanding Officer Navy Management Systems Support Office Norfolk, Virginia 23511	2
8.	LCDR Fred Braman, USN Commander Naval Air Forces, U.S. Atlantic Fleet Code 537 Norfolk, Virginia 23511	2
9.	Mr. Robert Jaurnig PMA-270 Naval Air Systems Command HQ Washington, D.C. 20361	2

10. CDR James W. Puffer, USN 1
Naval War College
Center for War Gaming, Code 331A
Newport, RI 02841

Th Thesis
P9 P94749 Puffer
c. c.1 An update of the functional requirements of the Naval Aviation Logistics Command Management Information System (NALCOMIS).

24 JAN 65 JAN 27 1986 3 1 2 1 2

Thesis
P94749 Puffer
c.1 An update of the functional requirements of the Naval Aviation Logistics Command Management Information System (NALCOMIS).

thesP94749
An update of the functional requirements
3 2768 001 93050 6
DUDLEY KNOX LIBRARY